Pebble Project

2006 Wetlands Study Update

Major Study Components

Delineation

Based on Criteria and Indicators Found in the 1987 Corps Wetland Delineation Manual & 2006 Interim Regional Supplement for the Alaska Region.

Classify Wetlands and Assess Their Functions

Magee Rapid Procedure for Assessing Wetland Functional Capacity (HGM Based)

Consider Wetland Values

Incorporate Subsistence, Recreation, Cultural Resource, and Other "Values" into the Functional Assessment Evaluation

Identify & Evaluate Potential Compensatory Mitigation Projects

Prepare Compensatory Mitigation Plan

Per June 10, 2004 Final Alaska District Compensatory Mitigation Guidelines

THREE
PARAMETERS+
Natural Resource Consulting

Three Parameters + Natural Resource Consulting

Status Report by Study Component

THREE PARAMETERS+
Natural Resource Consulting

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Three Parameters +   Natural Resource Consulting

Field Data Collection

Data QC/ Validation

Line Drawing

Polygon Coding

Field Review

Delineation
Wetlands and Other Waters of the U.S.

THREE PARAMETERS+
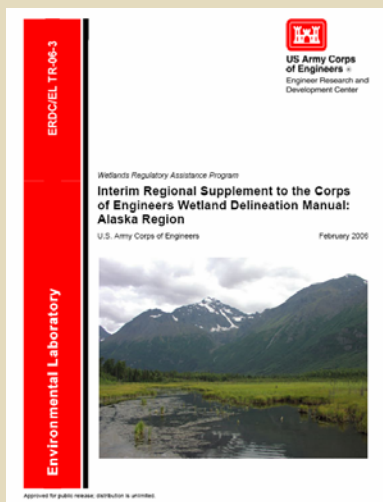Natural Resource Consulting

4

Field Work Was Complicated by the Spring Release of the:

Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region
Released March 22, 2006 – Effective for New Projects April 22, 2006

Three Parameters +   Natural Resource Consulting
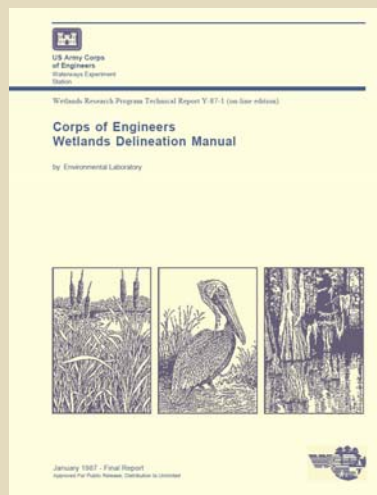
Both Methods Were Applied Concurrently at
Pebble During the 2006 Field Season

This resulted in a 6-8 page field form…

*and a lot of head scratching, teeth
grinding, and hair pulling….*
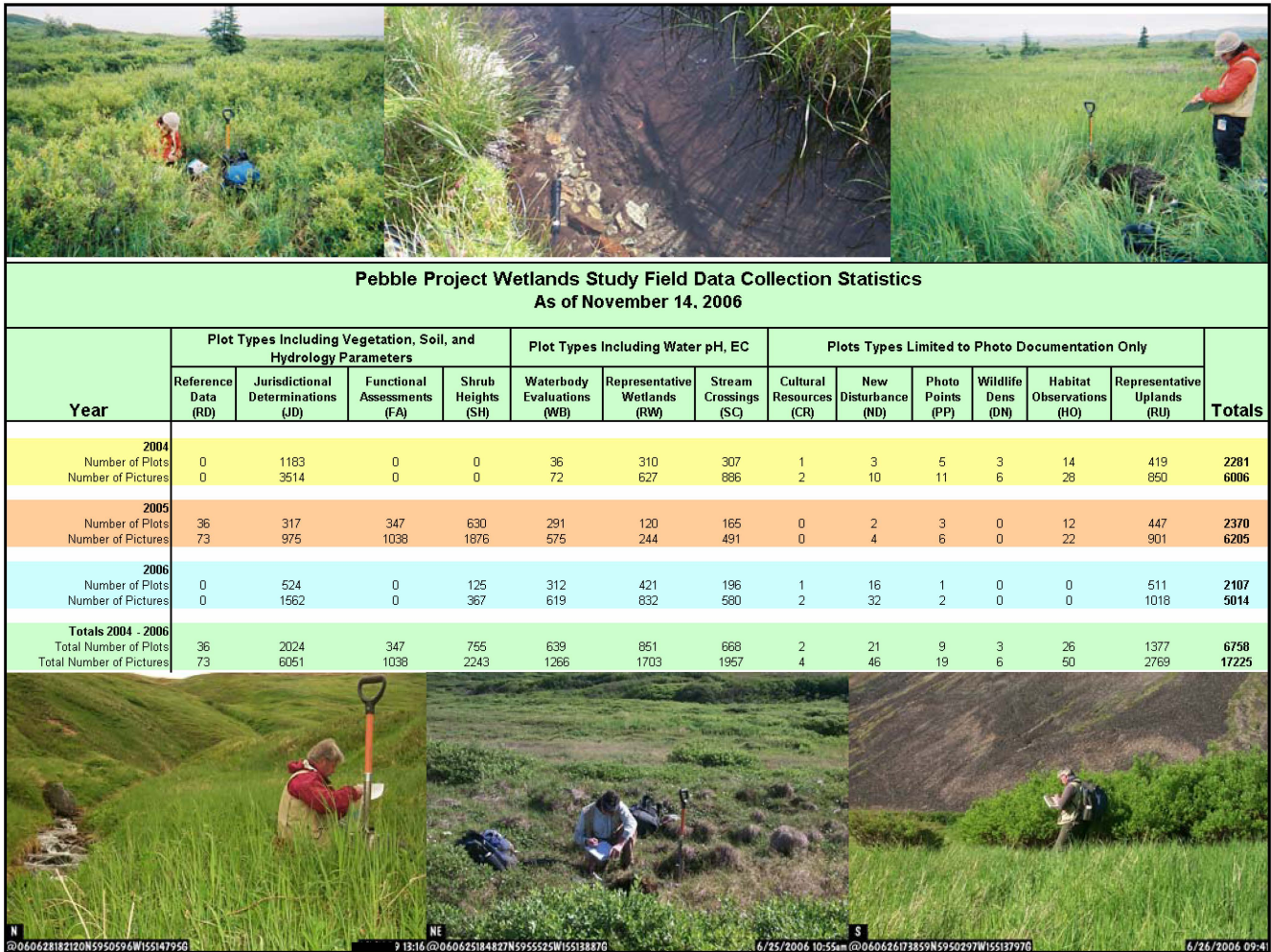
Three Parameters +

Natural Resource Consulting

And working later into the fall…

Starting our field season earlier…

THREE PARAMETERS+
Natural Resource Consulting

Pebble Project Wetlands Study Field Data Collection Statistics
As of November 14, 2006

Year	Plot Types Including Vegetation, Soil, and Hydrology Parameters				Plot Types Including Water pH, EC			Plots Types Limited to Photo Documentation Only						Totals
	Reference Data (RD)	Jurisdictional Determinations (JD)	Functional Assessments (FA)	Shrub Heights (SH)	Waterbody Evaluations (WB)	Representative Wetlands (RW)	Stream Crossings (SC)	Cultural Resources (CR)	New Disturbance (ND)	Photo Points (PP)	Wildlife Dens (DN)	Habitat Observations (HO)	Representative Uplands (RU)	
2004														
Number of Plots	0	1183	0	0	36	310	307	1	3	5	3	14	419	**2281**
Number of Pictures	0	3514	0	0	72	627	886	2	10	11	6	28	850	**6006**
2005														
Number of Plots	36	317	347	630	291	120	165	0	2	3	0	12	447	**2370**
Number of Pictures	73	975	1038	1876	575	244	491	0	4	6	0	22	901	**6205**
2006														
Number of Plots	0	524	0	125	312	421	196	1	16	1	0	0	511	**2107**
Number of Pictures	0	1562	0	367	619	832	580	2	32	2	0	0	1018	**5014**
Totals 2004 - 2006														
Total Number of Plots	36	2024	347	755	639	851	668	2	21	9	3	26	1377	**6758**
Total Number of Pictures	73	6051	1038	2243	1266	1703	1957	4	46	19	6	50	2769	**17225**

Three Parameters +   **Natural Resource Consulting**

Field Data Collection

Data QC/ Validation ←

Line Drawing

Polygon Coding

Field Review

Delineation
Wetlands and Other Waters of the U.S.

THREE PARAMETERS+
Natural Resource Consulting

Three Parameters +

Natural Resource Consulting

Field
Forms
Are
Typically
Reviewed
Each
Evening

Plants & Soils
Keyed

THREE
PARAMETERS+
Natural Resource Consulting

Three Parameters +

Natural Resource Consulting

Routine Wetland Determination

Last Saved:
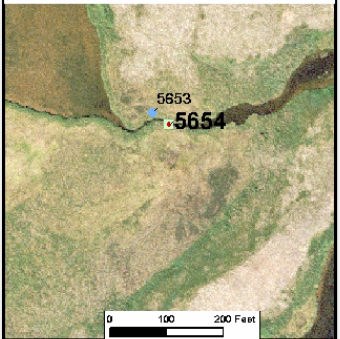
Show Menu: ☐ Plot: 3PP5654 QC Status: Data Entry Complete

Find Plot: 3PP Go Type: JD Status: Y

| Site Location | Vegetation | CRYP-AK06 | MORPH-AK06 | HYD-87 | HYD-AK06 | Soil Profile | Other Soil | Determination | Assessment | Save Plot | Show Model | Main Menu |

Project/Site: Pebble Project
Applicant/Owner: Northern Dynasty Minerals, Inc.
Investigator 1: CL   Christopher Love (3PP)
Investigator 2:
Investigator 3:
Do Normal Circumstances Exist? Yes
Is the Site Significantly Disturbed (atypical)? No
Vegetation? No   Soil? No   or Hydrology? No
Is the Site a Potential Problem Area (87 Manual)? No
Vegetation? No   Soil? No   or Hydrology? No
Naturally Problematic? (AK2006 Manual) No
Approximate Distance to Nearest Disturbance (ft):
Type of Disturbance (if any):

General location:

Lat Long Elev (Form): 59.56381   -155.19124   1115
Lat Long Elev (GIS): 59.943917   -155.320083   0

Plot/Photo Date: 9/9/2006 4:00:00 PM
County: Lake & Peninsula Borough
State: Alaska
Watershed: South Fork Koktuli
Add Watershed
(GIS)
Community ID:
Paper Plot/Tile No: 18
Ortho No:
Air Photo No:
Township: 03S   3S   (gps)
Range: 35W   35W   (gps)
Section: 5   5   (gps)
Quad No: ILID-7   ILID7   (gps)

Legend:
No Code, Water Body..., Reference Data, Uplands, Trans. Upland, Wetlands, Trans. Wetland, Rep. Upland, Rep. Wetland, Stream Crossing, Functional Assess., Photo Point, SH-Wetland, SH_Trans. Wetland, SH-Upland, SH-Trans. Upland, SH

5653
5654

0   100   200 Feet

New Data Types also Mean New Data Structures in the Wetlands Application of the Pebble Integrated Database

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Natural Resource Consulting

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Three Parameters +   Natural Resource Consulting

Vegetation Page Integrates 1987 and 2006 Methods, & Some Functional Assessment Variables

Routine Wetland Determination   Show Menu: ☐   Plot: 3PP6231   QC Status: Data Entry Complete ▼

Last Saved: ____   Find Plot: 3PP [Go]   Type: JD ▼   Status: N-T

| Site Location | Vegetation | CRYP-AK06 | MORPH-AK06 | HYD-87 | HYD-AK06 | Soil Profile | Other Soil | Determination | | Save Plot | Main Menu |

Acronym	Latin Name	Common Name	Stratum	Ind. Status	% Cover	Dom.	Height	Tree DBH	Magee Stratum	Delete
CACA ▼	Calamagrostis canadensis ▼	Blue-joint reedgrass ▼	H	FAC	85	Y			SH	☐
EPAN1 ▼	Epilobium angustifolium ▼	Fireweed ▼	H	FACU	15	N			SH	☐
EQAR ▼	Equisetum arvense ▼	Field horsetail ▼	H	FACU	10	N			SH	☐
ANLU ▼	Angelica lucida ▼	Seawatch angelica ▼	H	FACU		T	N		SH	☐
ACDE ▼	Aconitum delphinifolium ▼	Monkshood (larkspur-leaf) ▼	H	FAC		T	N		SH	☐
TREU ▼	Trientalis europaea ▼	European starflower ▼	H	FAC		T	N		SH	☐
HELA ▼	Heracleum lanatum ▼	Cow-parsnip ▼	H	FACU		T	N		TH	☐

% of Dominant Species that are OBL, FACW, or FAC (excluding FAC-): 100   Calculated: 100 %   [Calculate]   5 ▼ [Add Rows] [Delete Species] [Modify Species]

VEGETATION REMARKS

INDICATOR 1: PREVALENCE INDEX (AK2006)

	Total % Cover of (A)	Multiplied by (B)
OBL Species:		x 1 =
FACW Species:		x 2 =
FAC Species:	85	x 3 = 255
FACU Species:	25	x 4 = 100
UPL Species:		x 5 =
Column Totals:	110	355

Prevalence Index = B/A = 3.23   Calculated: 3.23

MISC. VEGETATION DATA

Project Veg Type: Bluejoint Meadow
Field BBMP Veg Type: Bluejoint Tall Grass (H1)
Viereck Code: IIIA2a ▼   ABR Hab Code: Hgmb ▼
Field JD Wet Code: U_10   Field ENVI Code: U: PEM1B
Field EROS Veg. Type: ____
Eros GIS: Closed shrub - graminoid
Trace =< (%) 3   Method: 50/20-Stratum   Proportion of Animal Food Plants (Calculated): 0

HYDROPHYTIC VEGETATION INDICATORS

	2006	1987
Prevalence Index - Indicator 1	No ▼	
Wetland Cryptograms - Indicator 2	▼	
Morphological Adaptations - Indicator 3	▼	
Meets Requirements for Problematic Wetland Situation?	▼	
Hydrophytic Vegetation Present?	No ▼	Yes ▼

% BY STRATUM (MAGEE - WETLANDS ONLY)

TREE = Canopy: 0 %   SAP = Sapling: 0 %   TS = Tall Shrub: 0 %
SS = Short Shrub: 0 %   DS = Dwarf Shrub: 0 %   TH = Tall Herb: 1.5 %
SH = Short Herb: 114.5 %   ML = Moss-Lichen: 0 %   F = Floating: 0 %
SUB = Submerged: 0 %   Number of Layers: 2

Three Parameters +

Natural Resource Consulting

| Site Location | Vegetation | **CRYP-AK06** | MORPH-AK06 | HYD-87 | HYD-AK06 | Soil Profile | Other Soil | Determination |

Bryophyte Type	% Cover Quad 1	% Cover Quad 2	% Cover Quad 3	Avg Quads 1 - 3	Calc Avg Quads 1 - 3
Aulacomnium palustre					
Blepharostoma trichophyllum					
Calliergon stramineum					
Calypogeia sphagnicola					
Drepanocladus sp.					
Meesia triquetra					
Meesia ulignosa					
Mylia anomala					
Pohlia proligera					
Polytrichum strictum					
Sphagnum angustifolium					
Sphagnum fuscum					
Sphagnum papillosum					
Sphagnum russowii					
Sphagnum squarrosum					
Sphagnum warnstorfii					
Tomentypnum nitens					
A. SubTotal (Wetland Bryophytes Above)					0
Other Moss					
Other Liverwort					
Other Hornwort					
B. SubTotal (Other Bryophytes Above)					0
C. TOTAL ALL BRYOPHYTES (A + B)					0
D. Avg. Total > 50% of Total Cover? (A/C)					No

Within Interior or South-central Alaska? ☐ (from GIS).
Within Black Spruce Forest mapping unit? ☐
Wetland Cryptogams - Indicator 2 ☐

Cryptogam
Page Was
Designed –

But Was
Not Utilized
During the
2006 Field
Season

Three Parameters +

Natural Resource Consulting

Save Plot | Main Menu

Adapted FACU Species	% Cov Stunted	% Cov Multiple Trunks	% Cov Rotten Core	% Cov Altered Growth Form	% Cov Other	Other Adaptation Description	Total % Cov Adaptations	Total % Cov	>50% Adapted?	PHOTOS
Angelica lucida (ANLU)										
Epilobium angustifolium (EPAN1)										
Equisetum arvense (EQAR)										
Heracleum lanatum (HELA)										
Comments:							Number of Species Where >50% Adapted			

Adjacent Site ▼ Lat/Long [ ] [ ] GPS Lat/Long [ ] [ ]

Angelica lucida (ANLU)										
Epilobium angustifolium (EPAN1)										
Equisetum arvense (EQAR)										
Heracleum lanatum (HELA)										
Comments:							Number of Species Where >50% Adapted			

☐ Delete

Adjacent Site ▼ Lat/Long [ ] [ ] GPS Lat/Long [ ] [ ]

Angelica lucida (ANLU)										
Epilobium angustifolium (EPAN1)										
Equisetum arvense (EQAR)										
Heracleum lanatum (HELA)										
Comments:							Number of Species Where >50% Adapted			

☐ Delete

Adjacent Site ▼ Lat/Long [ ] [ ] GPS Lat/Long [ ] [ ]

Angelica lucida (ANLU)										
Epilobium angustifolium (EPAN1)										
Equisetum arvense (EQAR)										
Heracleum lanatum (HELA)										
Comments:							Number of Species Where >50% Adapted			

Morphological Adaptation Page Auto-populates with FACU Species

☐ Delete

Plot 202 of 229   << previous   100 ▼   next >>   Go To Next Tab

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Three Parameters +   Natural Resource Consulting

| Site Location | Vegetation | CRYP-AK06 | MORPH-AK06 | HYD-87 | **HYD-AK06** | Soil Profile | Other Soil | Determination | | **Save Plot** | **Main Menu** |

PRIMARY INDICATORS

No ▼ Surface Water (A1)
No ▼ High Water Table (A2)
No ▼ Saturation (A3)
No ▼ Water Marks (B1)
No ▼ Sediment Deposits (B2)
No ▼ Drift Deposits (B3)
No ▼ Mat or Crust of Algae or Marl (B4)
No ▼ Iron Deposits (B5)

No ▼ Surface Soil Cracks (B6)
No ▼ Inundation Visible on Aerial Imagery (B7)
No ▼ Sparsely Vegetated Concave Surface (B8)
No ▼ Hydrogen Sulfide Odor (C1)
No ▼ Dry-Season Water Table (C2)
No ▼ Other (Explain in Comments)

SECONDARY INDICATORS

No ▼ Water-stained Leaves (B9)
No ▼ Drainage Patterns (B10)
Yes ▼ Oxidized Rhizospheres on Living Roots (C3)
No ▼ Presence of Reduced Iron (C4)
No ▼ Salt Deposits (C5)
No ▼ Stunted or Stressed Plants (D1)
No ▼ Geomorphic Position
No ▼ Shallow Aquitard (D3)
Yes ▼ Microtopographic Relief (D4)
No ▼ FAC-Neutral Test (D5)
No ▼ Calculated FAC-Neutral Test

FIELD OBSERVATIONS (INCHES):

Surface Water Present? No ▼   Depth of Surface Water: N/A
Water Table Present? No ▼   Depth to Free Water N/A
  Depth to Ice in Pit: N/A
Impeding Layer? No ▼   Depth to Impeding Layer: N/A
Impeding Layer Type
Saturated Soil Present? No ▼   Depth to Saturated Soil: N/A

Are climate/hydrologic conditions on the site typical for this time of year? Yes ▼
Climate Comments:
moist organic soil, possibly from recent rains.
Hydrology Comments:
slightly benched

Wetland Hydrology Present (AK2006)? Yes ▼

2006 Hydrology Page Carries Over Equivalent Data from 87 Page and Houses New Fields/Data

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Natural Resource Consulting

Several Soil Profile Page Updates Were Also Implemented

The Other Soil Page Provides 1987 and 2006 Soil Indicator Data

Three Parameters + **Natural Resource Consulting**

Routine Wetland Determination

Show Menu: ☐ Plot: 3PP6297 QC Status: Data Entry Complete ▼

Last Saved: Other Soils Tab @ 3:11:43 PM Find Plot: 3PP [Go] Type: JD ▼ Status: Y

Site Location | Vegetation | CRYP-AK06 | MORPH-AK06 | HYD-87 | HYD-AK06 | Soil Profile | **Other Soil** | Determination | Assessment | **Save Plot** | **Show Model** | **Main Menu**

COE 1987 MANUAL HYDRIC SOIL INDICATORS:

Hydric Per 1987 COE Manual? Yes ▼

No ▼ Histosol (16+")	No ▼ Gleyed or Low-Chroma Colors
Yes ▼ Histic Epipedon (8-16")	No ▼ High Organic Content Surface Layer Sandy Soils
No ▼ Sulfidic Odor	No ▼ Organic Streaking in Sandy Soils
No ▼ Aquic Moisture Regime	No ▼ Listed on Local Hydric Soils List
No ▼ Reducing Conditions	No ▼ Listed on National Hydric Soils List

OTHER SOIL REMARKS:

Depth of Organic Mat (inches) 15

Depth to Permafrost (inches) N/A

Major Rooting Zone (inches) 6

Soil Temperature (12" Below Surface) 46 F ▼

No ▼ Cryoturbated No ▼ Thixotropic

NRCS-NTCHS:

Hydric Per NRCS-NTCHS Indicators / AK 2006? Yes ▼ 10 ▼ [Add Rows]

2006	2005	Ref	2004	Ref	Delete
A2 - Histic Epipedon ▼	A2 - Histic Epipedons ▼	ref	A2 - Histic Epipedons ▼	ref	Delete
4d - Ponded/Flooded/H ▼	- ▼	ref	- ▼	ref	Delete
▼	▼		▼		Delete
▼	▼		▼		Delete
▼	▼		▼		Delete

Profile Comments:

	1987	2006
Hydric Soils Present?	Yes ▼	Yes ▼

Determination Page Summarizes Results from Both Methods & FA Model Output

Special thanks to Dan Van Orden & the programmers at Resource Data, Inc. for implementing all these changes with rather sporadic and often incoherent input from me….

Mine Site Study Area Was Expanded to Include additional work in the East Deposit area in 2006

The mapping process is very slow, because of the large number of vegetation types and their high degree of interspersion across the landscape
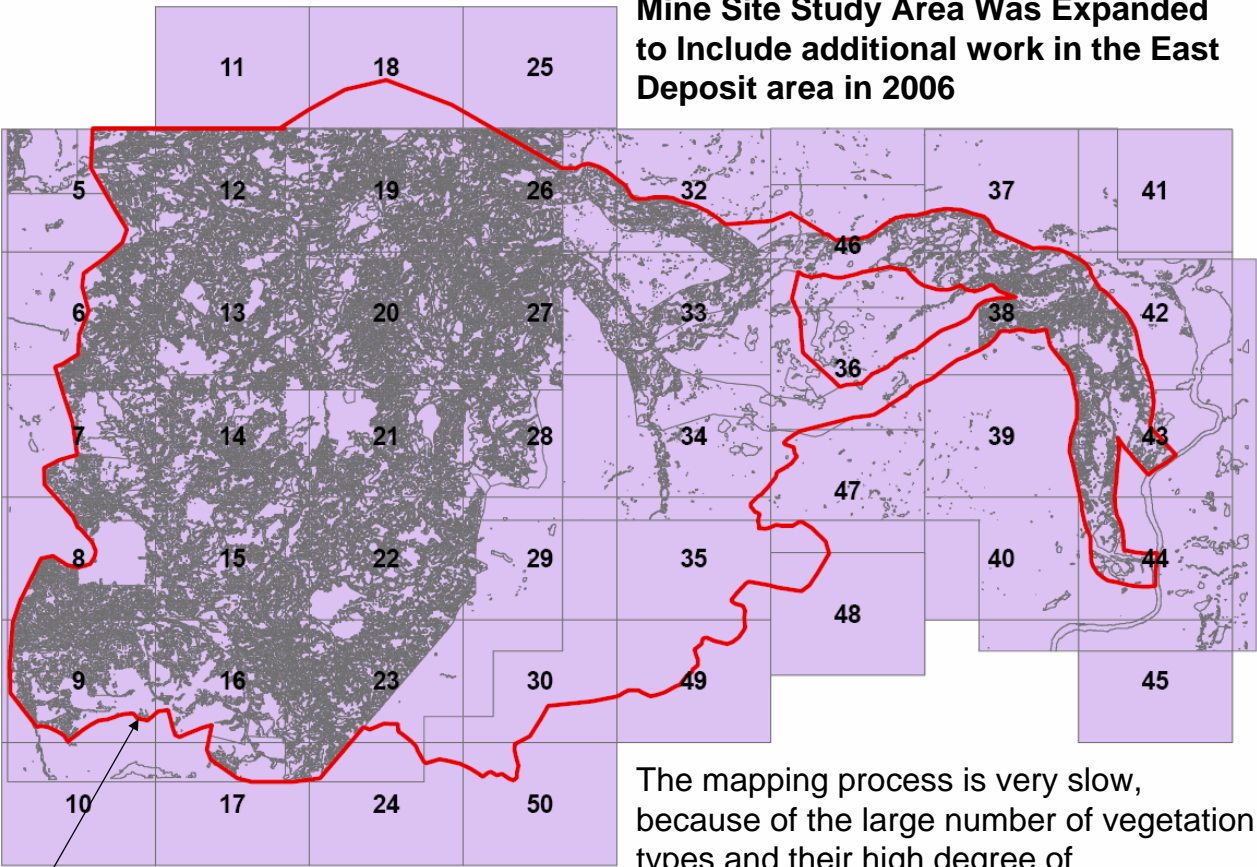
Red Study Area Boundary = 104,069 Acres

With so many polygons and people mapping, developing a process to insure consistency was very important.

Jon Hall assumed the lead in this task, ultimately producing the Draft Mine Site Vegetation Type Photo Signature Guide in April of 2006.

This will be updated to include several new vegetation types identified in the Upper Talarik in the coming months.
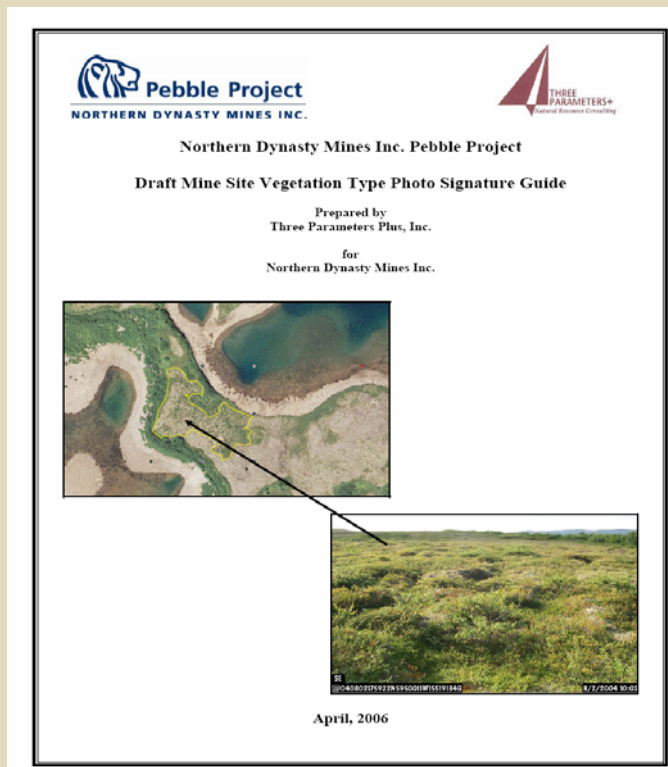
Forested Cover Types Being Mapped

- Black Spruce Woodland

- Closed Mixed Forest

- Dwarf White Spruce Woodland

- Open Balsam Poplar Forest

- Open Mixed Forest

- Spruce Paper Birch Woodland

- White Spruce Woodland

THREE PARAMETERS+
Natural Resource Consulting

Shrub Cover Types Being Mapped

- Closed Alder Tall or Low Shrub
- Closed Alder-Willow Tall Shrub
- Closed Willow Tall or Low Shrub
- Dwarf Ericaceous Shrub Lichen Tundra
- Dwarf Ericaceous Shrub Tundra
- Ericaceous Shrub Bog
- Low Ericaceous Shrub Tundra
- Mixed Shrub-Sedge Tussock Tundra
- Open Alder Tall or Low Shrub
- Open Alder-Willow Tall Shrub
- Open Dwarf Birch- Ericaceous Shrub – Sphagnum Bog
- Open Willow Tall or Low Shrub
- Shrub Birch – Willow

THREE PARAMETERS+
Natural Resource Consulting

Herbaceous Cover Types Being Mapped

- Bluejoint Herb

- Bluejoint Tall Grass

- Fresh Herb Marsh

- Fresh Sedge Marsh

- Mesic Herb

- Subarctic Sedge-Moss Wet Meadow

- Partially Vegetated

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Three Parameters +
Natural Resource Consulting

Other Cover Types Being Mapped

- Barren

- Snow

- Open Water
  - Perennial Ponds
  - Seasonal Ponds
  - Beaver Backwaters
  - Lakes
  - Rivers
  - Oceans

- Beaver Dams/Lodges

THREE PARAMETERS+
Natural Resource Consulting

How Many Cover Types Do You See?

Three Parameters +

Natural Resource Consulting

Photo delineation has been complicated by the mid-summer photography acquisition, which resulted in many different shrubs having the very similar colors and texture…
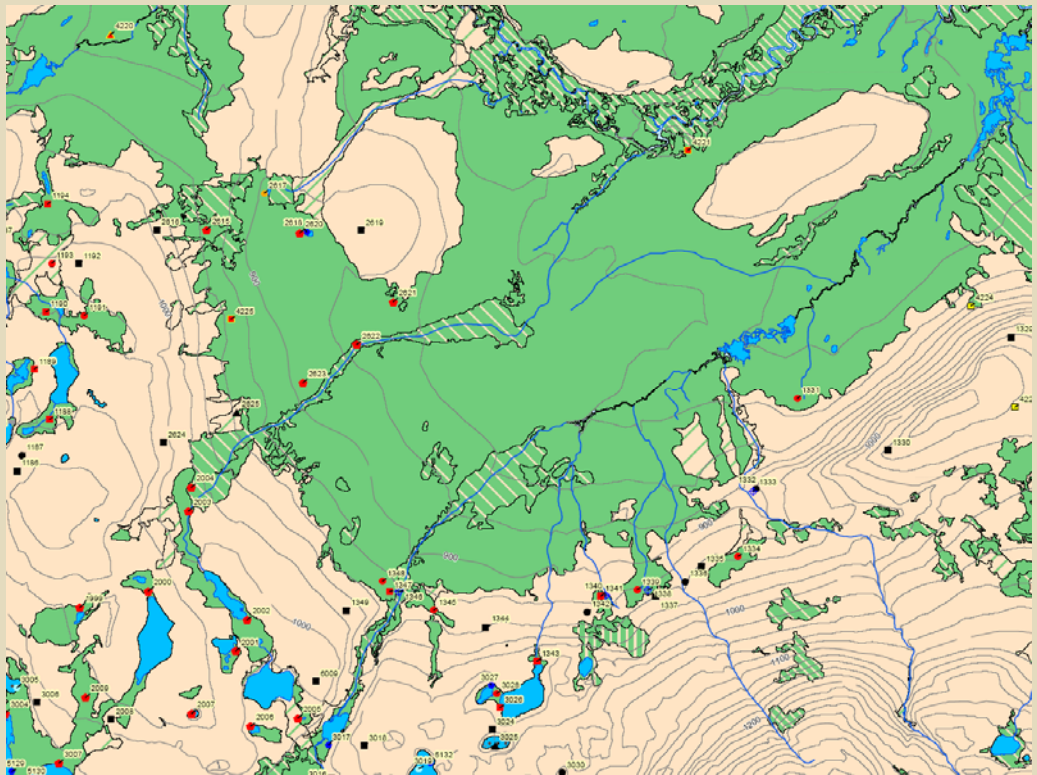
Note how willows are clearly gold in the fall, while alders stay green.
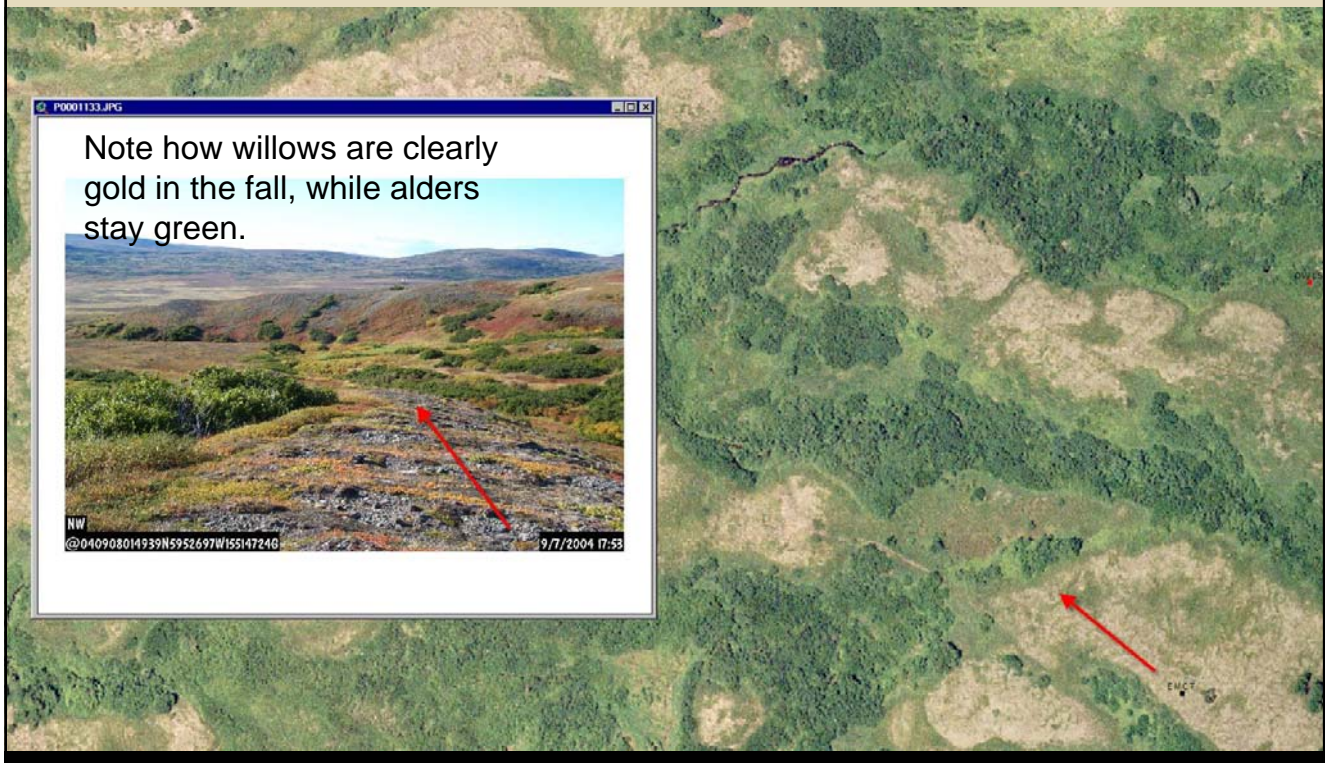
Three Parameters +

Natural Resource Consulting

Sample Jurisdictional Wetland Mapping

As such it will still be many months before the preliminary mapping is complete for the potentially affected watersheds…

Three Parameters +

Natural Resource Consulting

Field Data Collection

Data Validation

Line Drawing

Polygon Coding

Agency Field Reviews

Delineation
Wetlands and Other Waters of the U.S.

THREE PARAMETERS+
Natural Resource Consulting

Major Study Components

Delineation

Based on Criteria and Indicators Found in the 1987 Corps Wetland Delineation Manual &
2006 Interim Regional Supplement for the Alaska Region.

Classify Wetlands and Assess Their Functions

Small Pools Study
Magee Rapid Procedure for Assessing Wetland Functional Capacity (HGM Based)

Consider Wetland Values

Incorporate Subsistence, Recreation, Cultural Resource, and Other "Values" into the Functional
Assessment Evaluation

Identify & Evaluate Potential Compensatory Mitigation Projects

Prepare Compensatory Mitigation Plan

Per June 10, 2004 Final Alaska District Compensatory
Mitigation Guidelines

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Three Parameters +

Natural Resource Consulting

Determine HGM Classification ←

Collect Key Data (Inlets/Outlets, pH)

Run Models Using Field & Photo Interpreted Data

Multiply Scores of Potentially Impacted Wetlands x Acres Affected

Determine Debits by Function

Classify Wetlands and Assess Their Functions

Magee Holland's Rapid Procedure for Assessing Wetland Functional Capacity

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Three Parameters +
Natural Resource Consulting

Determine HGM Classification

HGM Classification is based on the predominant hydrologic influence on the wetland:

- Groundwater (Slope…no, it makes no sense)
- Precipitation (Flats…no, it makes no sense)
- Flooding from Adjacent Rivers & Streams (Riverine)
- Adjacent Lakes (Lacustrine Fringe)
- Tidal Influences (Coastal Fringe)

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Ongoing Classification and Ecohydrological Studies of Waters of the U.S., Including Wetlands, on the Pebble Project, Southwest Alaska

Mark Cable Rains, Ph.D.
Coshow Environmental, Inc., Temple Terrace, FL, USA
&
University of South Florida, Tampa, FL, USA

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The emphasis in this title is on "Ongoing…"

My intent is not to provide a complete accounting of my overall efforts but, rather, to provide some insight into my overall efforts through an accounting of some of my more advanced individual efforts.

Objectives

- To identify the hydrogeomorphic subclasses of waters of the U.S., including wetlands, that occur on the Pebble Project

- To quantify the hydrological processes that govern the ecosystem structure and function of the hydrogeomorphic subclasses of waters of the U.S., including wetlands, that occur on the Pebble Project

Reconnaissance Transects and Sample Locations
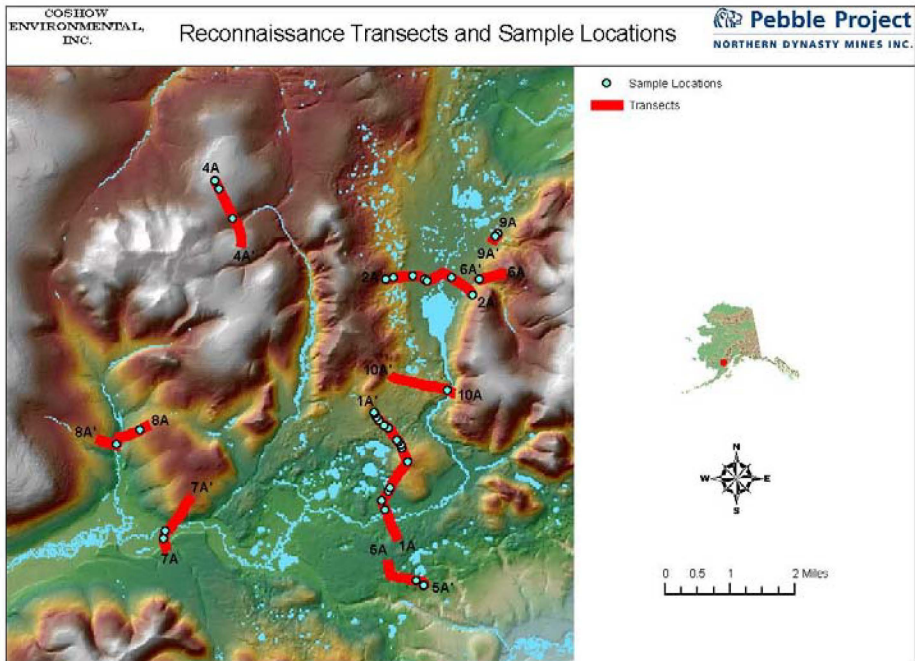
Potential Hydrogeomorphic Subclasses

- Riverine
  - Headwater
  - Mainstem
- Slopes
  - Seeps/Springs
  - Diffuse Flow
- Depressions
  - Perched Precipitation
  - Groundwater Flow Through

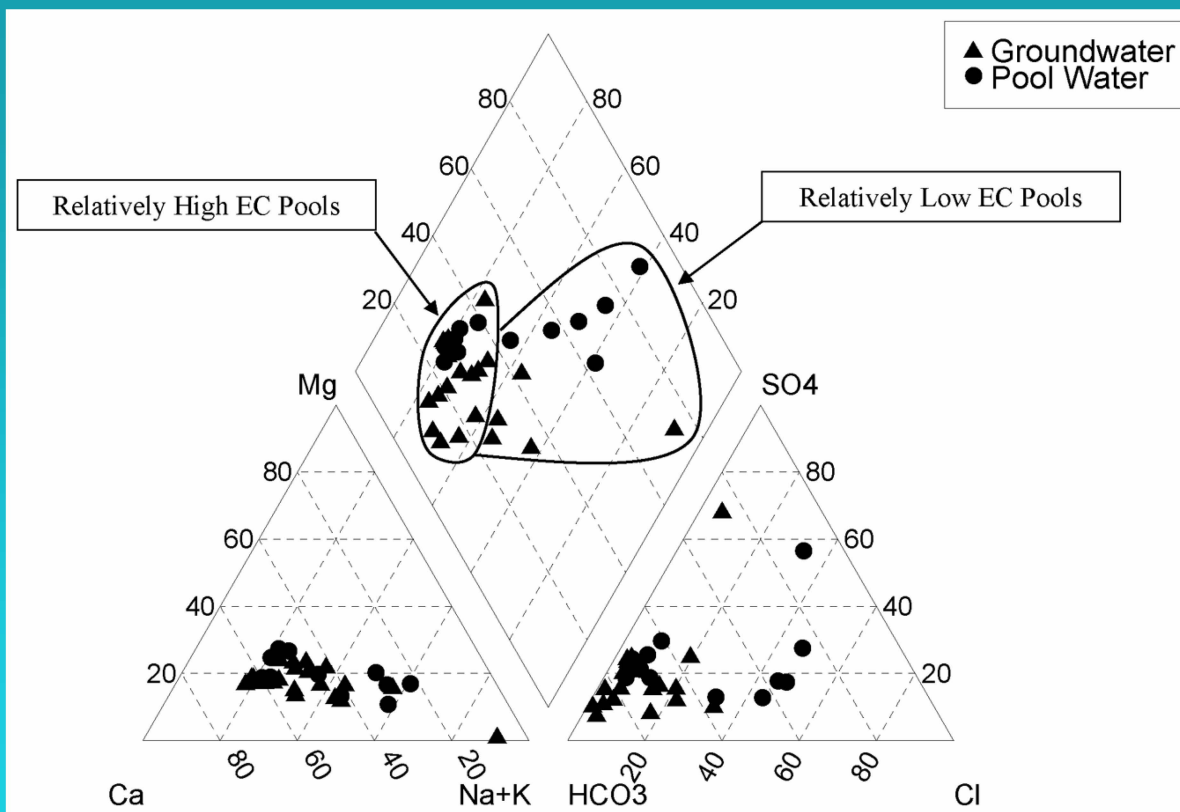Precipitation, Spring, and River Electrical Conductivity
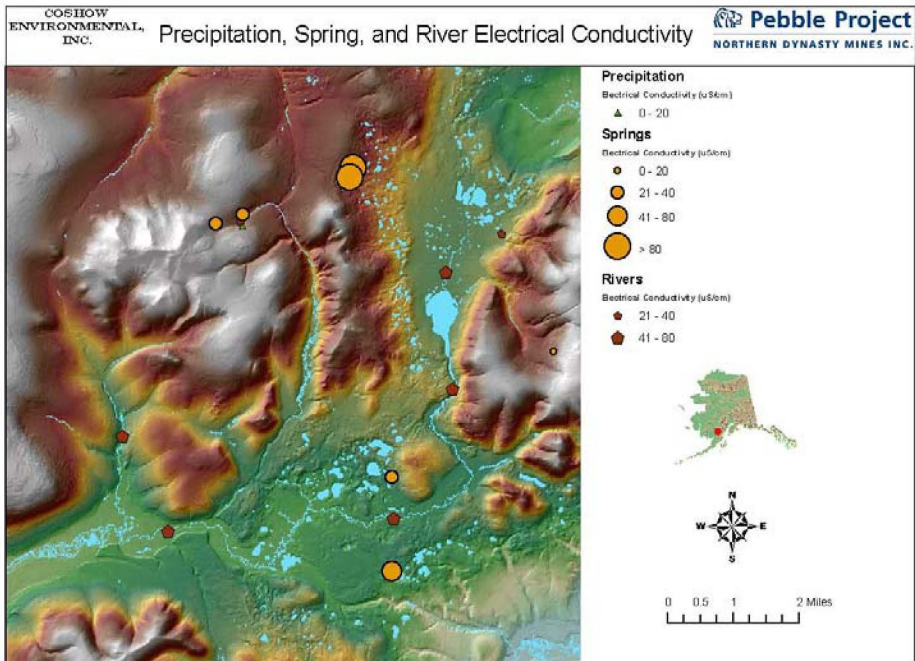
Depressional Wetland Electrical Conductivity
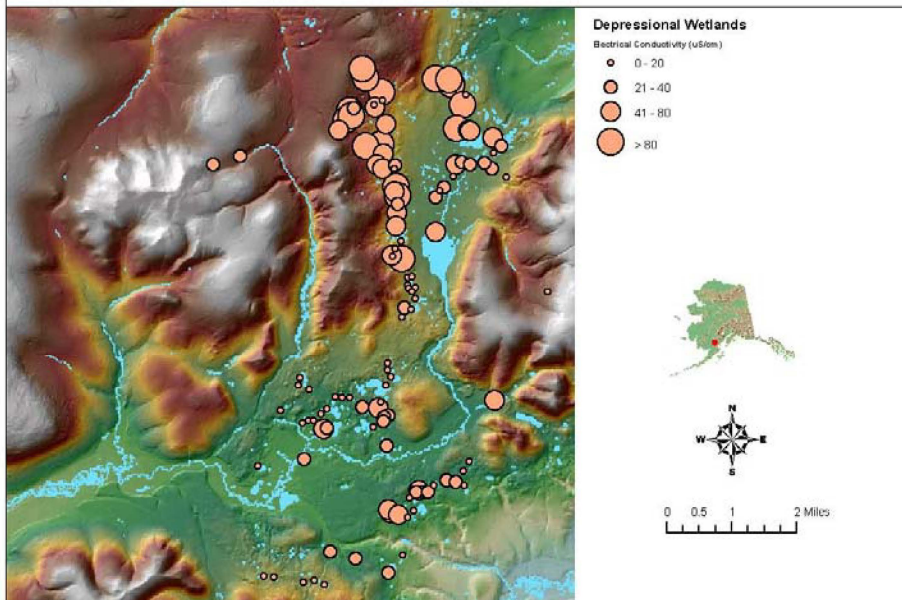
Field Measurements

- Pool Stage
- Groundwater Head
- Field Chemistry (T, pH, EC)
- Dissolved Constituents (Na, K, Mg, Ca, Cl, SO_4, HCO_3, CO_3, Si)
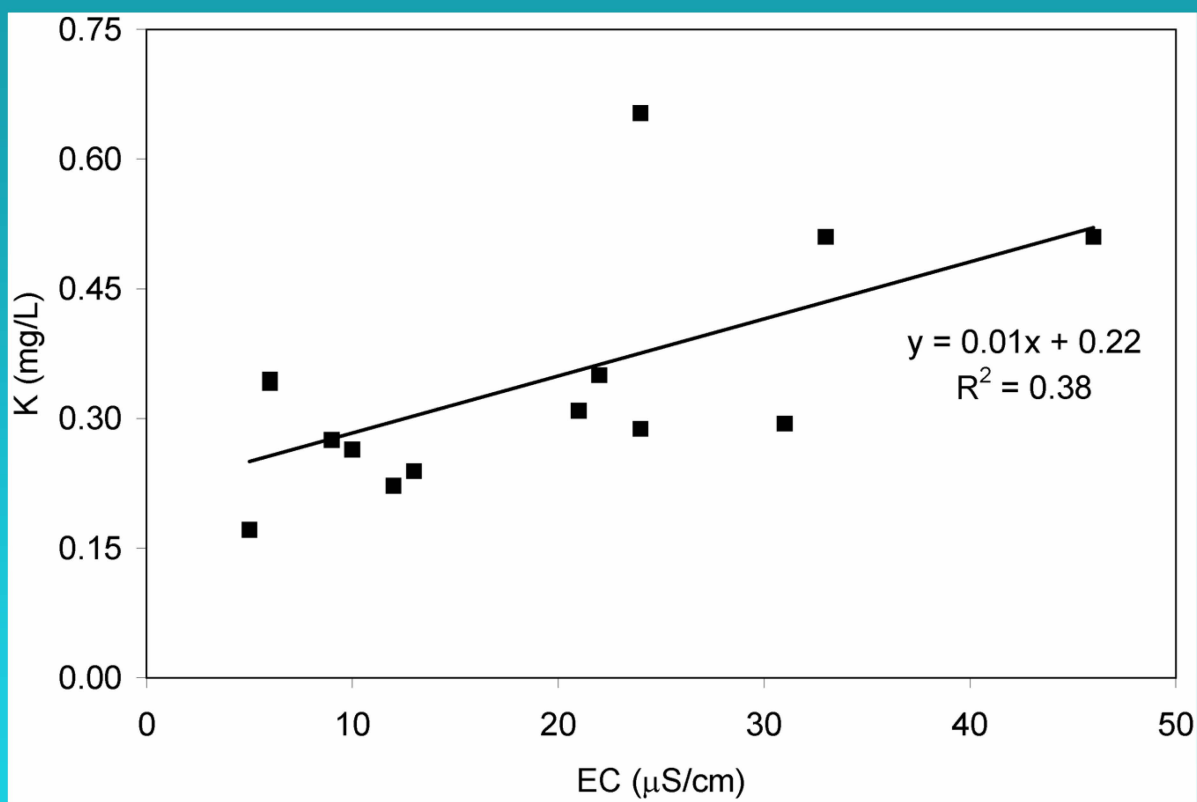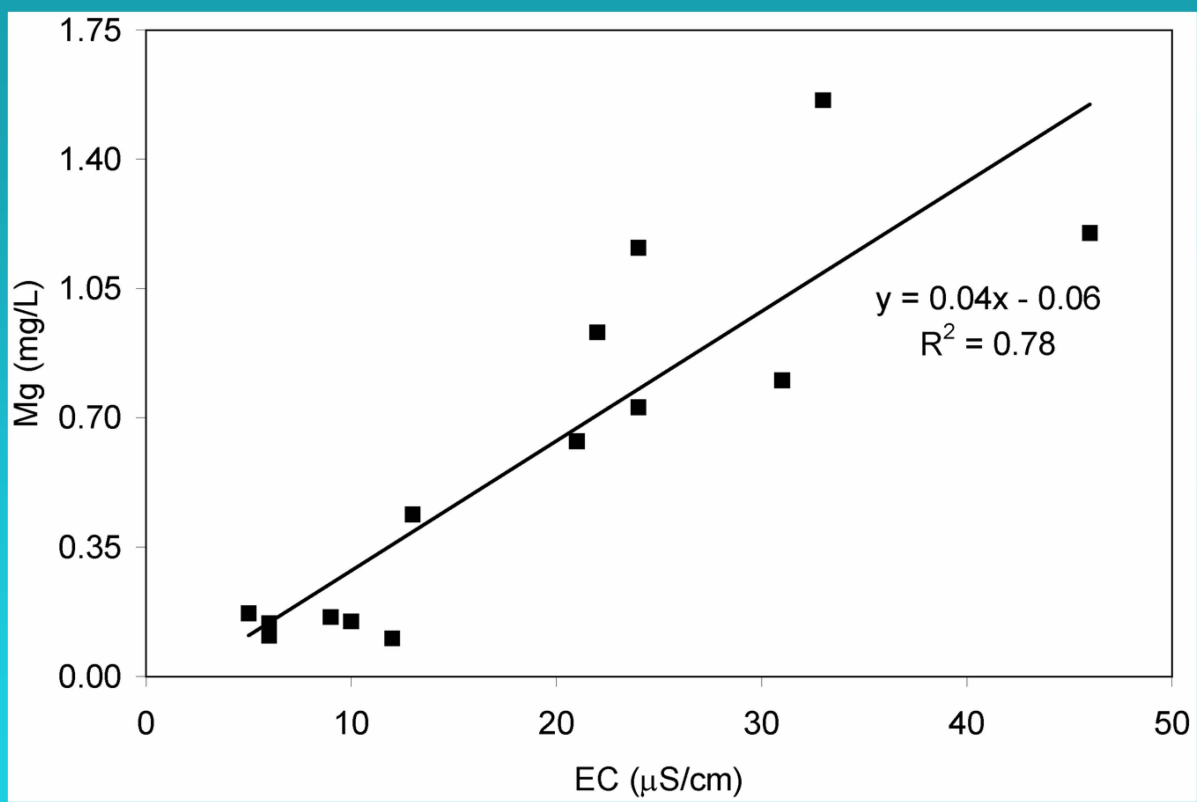- Stable Isotopes (D, ^{18}O)

Hypothesis

Pool electrical conductivity is controlled by water source, with some pools being perched-precipitation pools and other pools being groundwater flow-through pools.
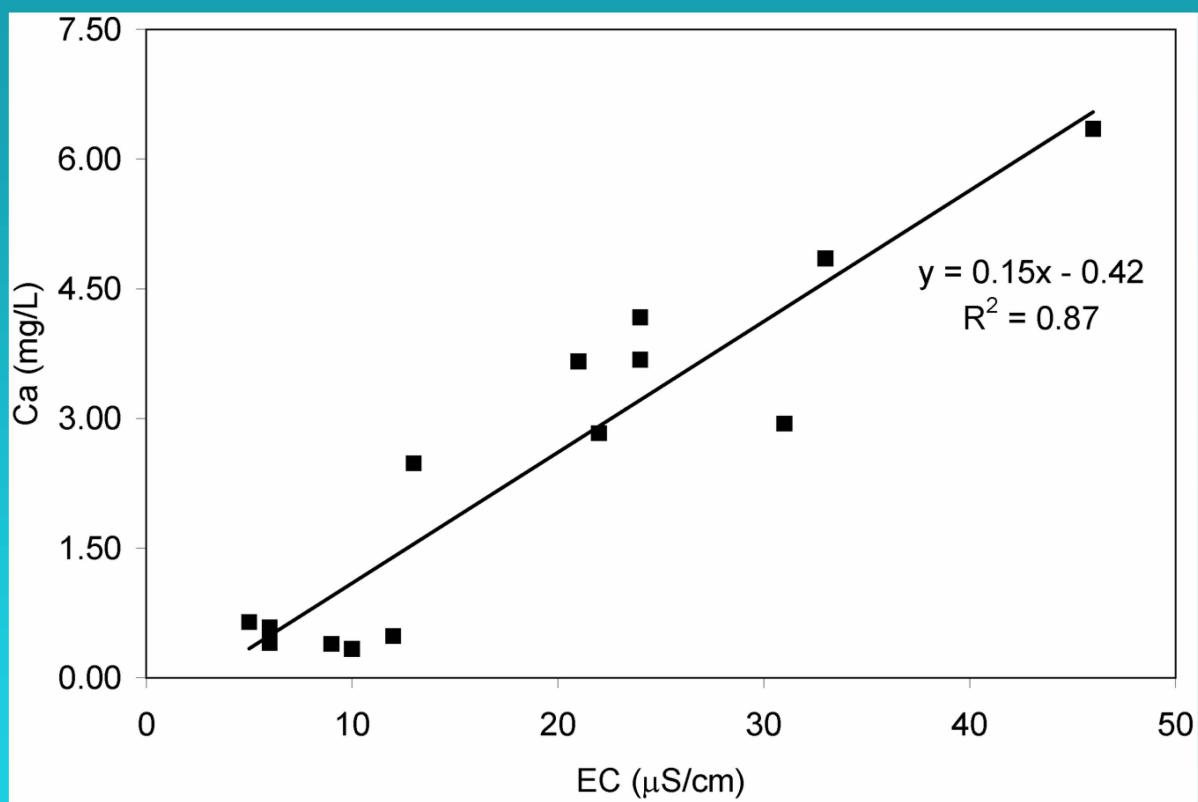
- Evaporation Control
  - Proportional concentration of all relatively conservative dissolved constituents

- Water-Rock Interaction Control
  - Preferential concentration of relatively conservative dissolved constituents common in sediments
  - Sediments largely derived from granodiorite, quartz monzonite, and quartz diorite (Na, K, Mg, Ca, Si common; Cl not common)
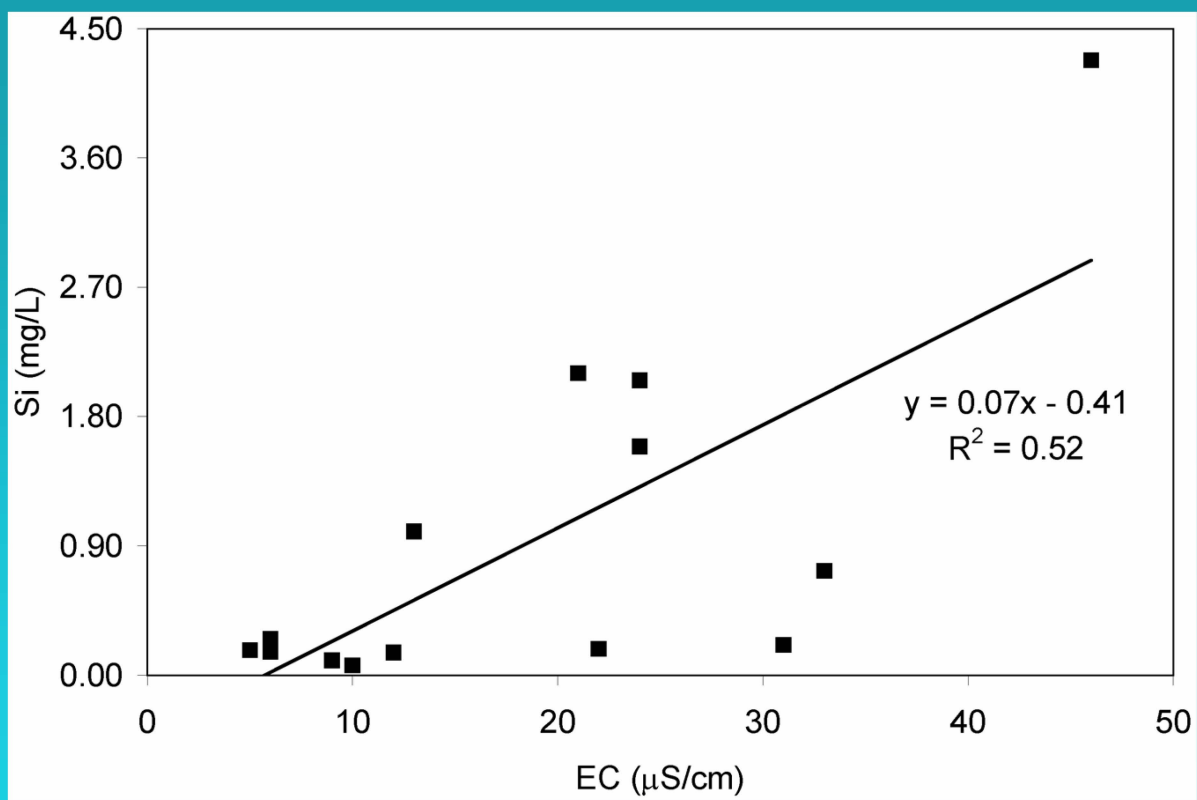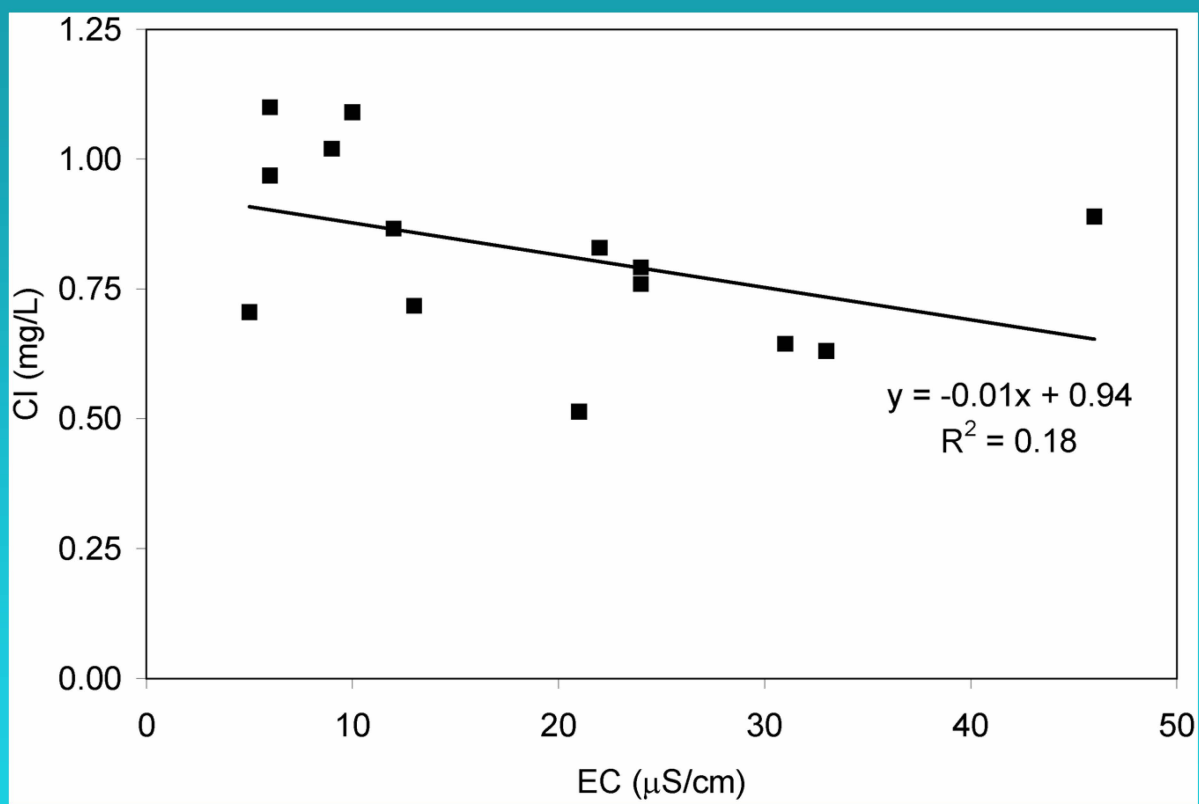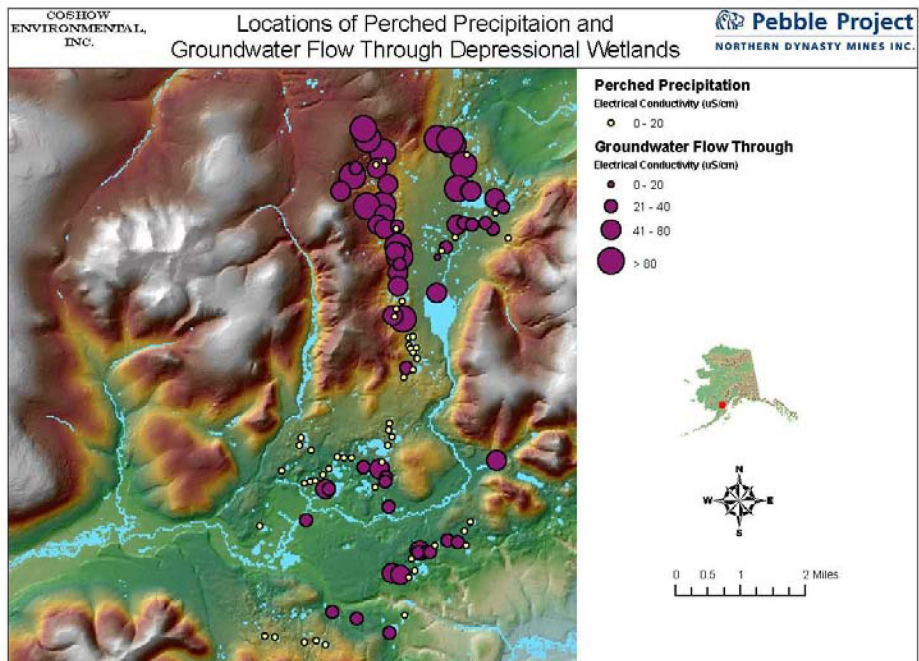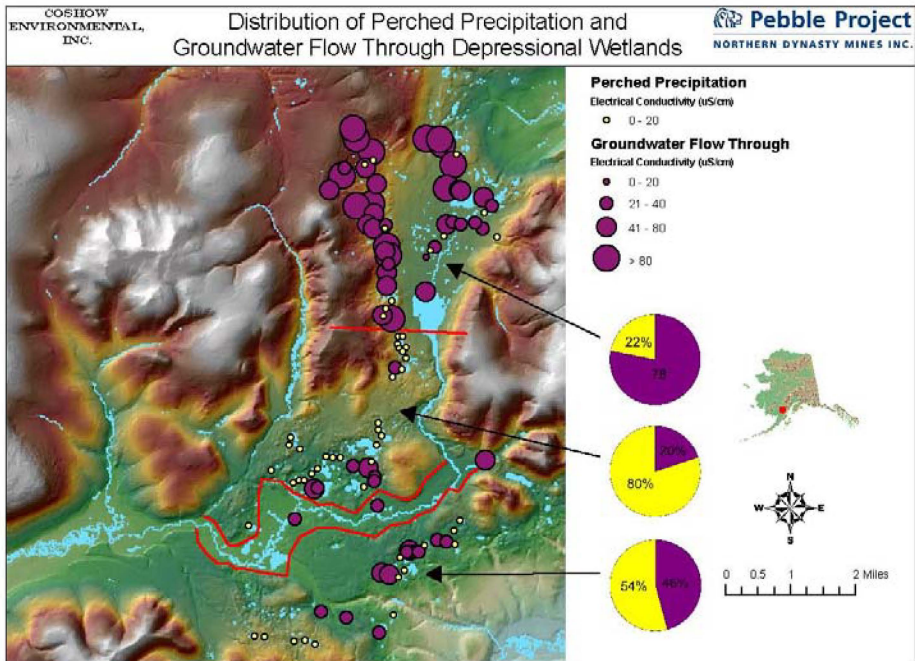
Locations of Perched Precipitaion and Groundwater Flow Through Depressional Wetlands

Transect 1 - Pools

1A — 1A'

Hillslope with solifluction terraces with shrub willow and alder

Pools with perched-precipitation signatures

Extreme high flow swale

Combined groundwater recharge unknown, but must be relevant because EC is so low.

Q Q

328
324
320
316
312

Vertical Exaggeration = 4x

0 20 40 60 meters
Horizontal Scale
0 10 20 30 meters
Vertical Scale

- - - Water table, interpolated from wells
Sand and Gravel
Silty Sand and Gravel

Transect 5 Pools
Page 1

5A

Combined spring discharge >1700 m3/d on 26 June 2005

Seeps/springs

Pools with groundwater-flow-through signatures

Combined groundwater recharge >1700 m3/d on 26 June 2005

- - - Water table, interpolated from wells

Sand and Gravel

Vertical Exaggeration = 4x

Horizontal Scale

0   40   80   120 meters

Vertical Scale

0   10   20   30 meters

Next Steps

- Expand the small pools study to the Upper Talarik and NF Koktuli Basins
- Develop plans for similar studies of other hydrogeomorphic subclasses of waters of the U.S., including wetlands, on the Pebble Project

Three Parameters +
Natural Resource Consulting

So Now You Know Why We All Look Like Traveling Salesmen Wandering Around the Tundra

Conductivity Meters

Three Parameters +

Natural Resource Consulting

Classify Wetlands and Assess Their Functions

Magee Holland's Rapid Procedure for Assessing Wetland Functional Capacity

Determine HGM Classification

Collect Key Data (Inlets/Outlets, pH)

Run Models Using Field & Photo Interpreted Data

Multiply Scores of Potentially Impacted Wetlands x Acres Affected

Determine Debits by Function

THREE PARAMETERS +
Natural Resource Consulting

Magee Method Variables

- Wetland Size
- Ratio of Wetland Area to Watershed Area
- Juxtaposition
- Land Use/Intensity
- Soil Type
- Underlying Surficial Deposit
- Micro-Relief
- Water Regime
- Surface Water Fluctuation
- Overbank Flooding Frequency
- Sedimentation Evidence
- Basin Topography

- Inlets/Outlet Types
- Outlet Restrictions
- Water pH
- Piezometer Data (where available)
- Seeps & Springs
- Vegetation Types
- Vegetation Density/Dominance
- Interspersion
- Species Diversity
- Animal Food Plants
- Islands
- Woody Debris

THREE PARAMETERS+
Natural Resource Consulting

The various data are entered into the database, where they are input into each model according to the methodology.

We'll be "Alaskanizing" the models in the coming months to make sure that they reflect the logic of the existing HGM models for Alaska and other ideas from the project team and interested agency representatives.

Three Parameters +

Natural Resource Consulting

A Sample of Preliminary Model 1 Scores
Modification of Groundwater Discharge

Three Parameters +   **Natural Resource Consulting**

**A Sample of Preliminary Model 2 Scores
Modification of Groundwater Recharge**

Three Parameters +
Natural Resource Consulting

A Sample of Preliminary Model 3 Scores (Storm & Flood Water Storage)

Three Parameters +

Natural Resource Consulting
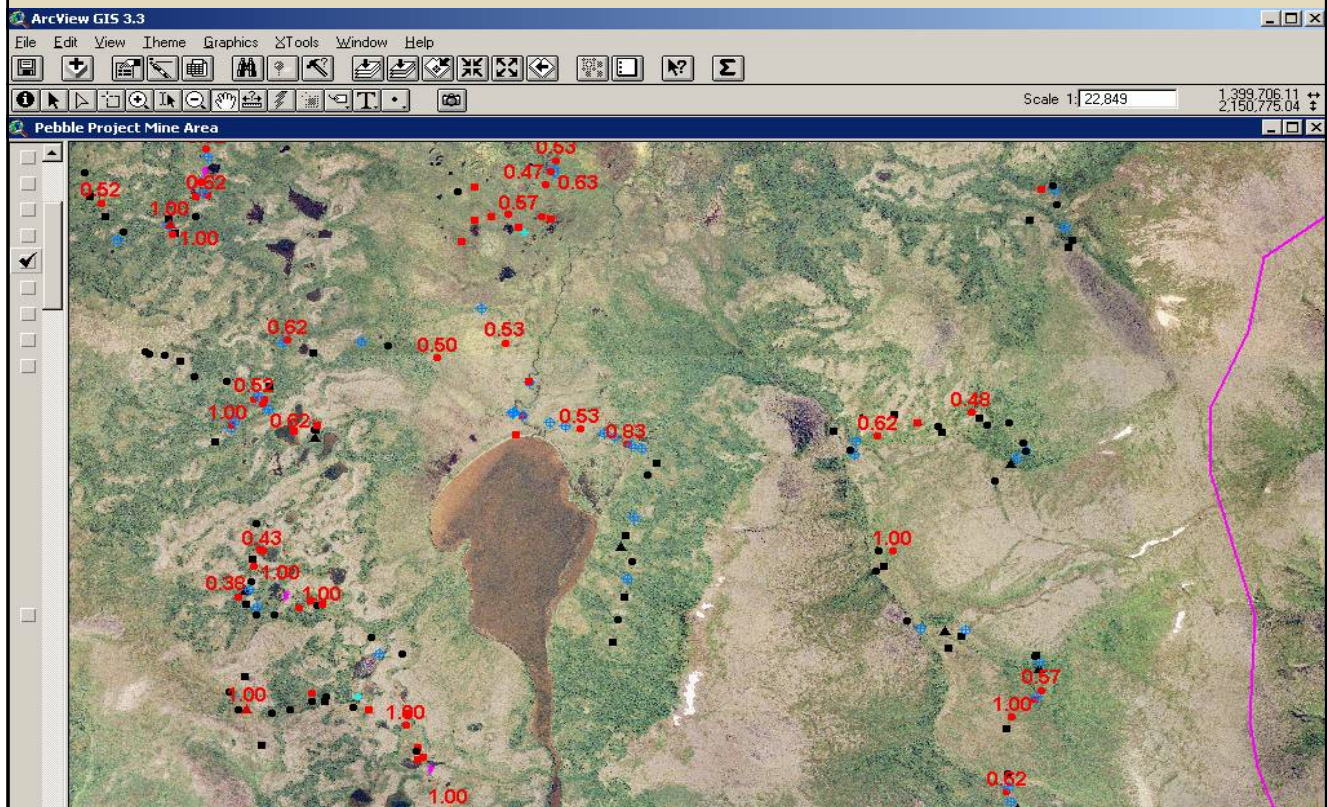
A Sample of Preliminary Model 4 Results

Modification of Stream Flow Function (Combination of Models 1 & 3)

Three Parameters +

Natural Resource Consulting
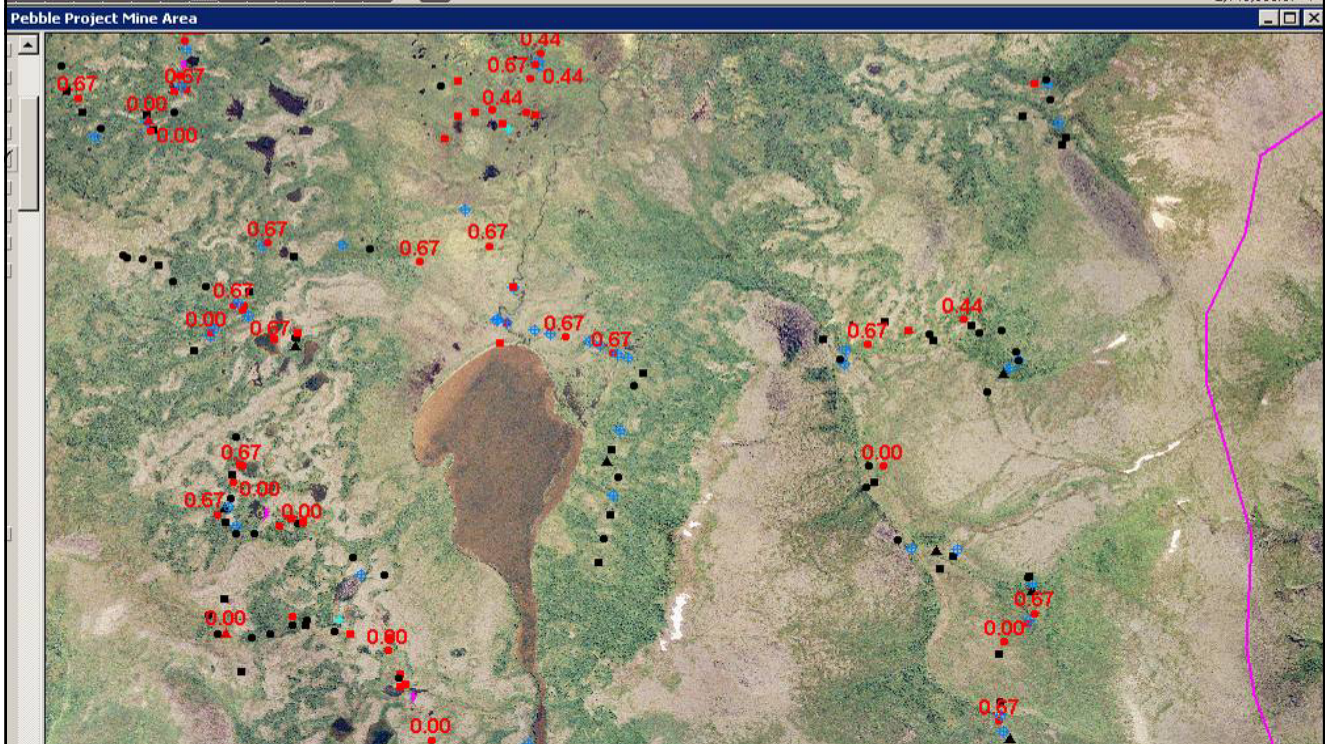
A Preliminary Sampling of Model 5 Results
Modification of Groundwater Quality

Three Parameters +

Natural Resource Consulting
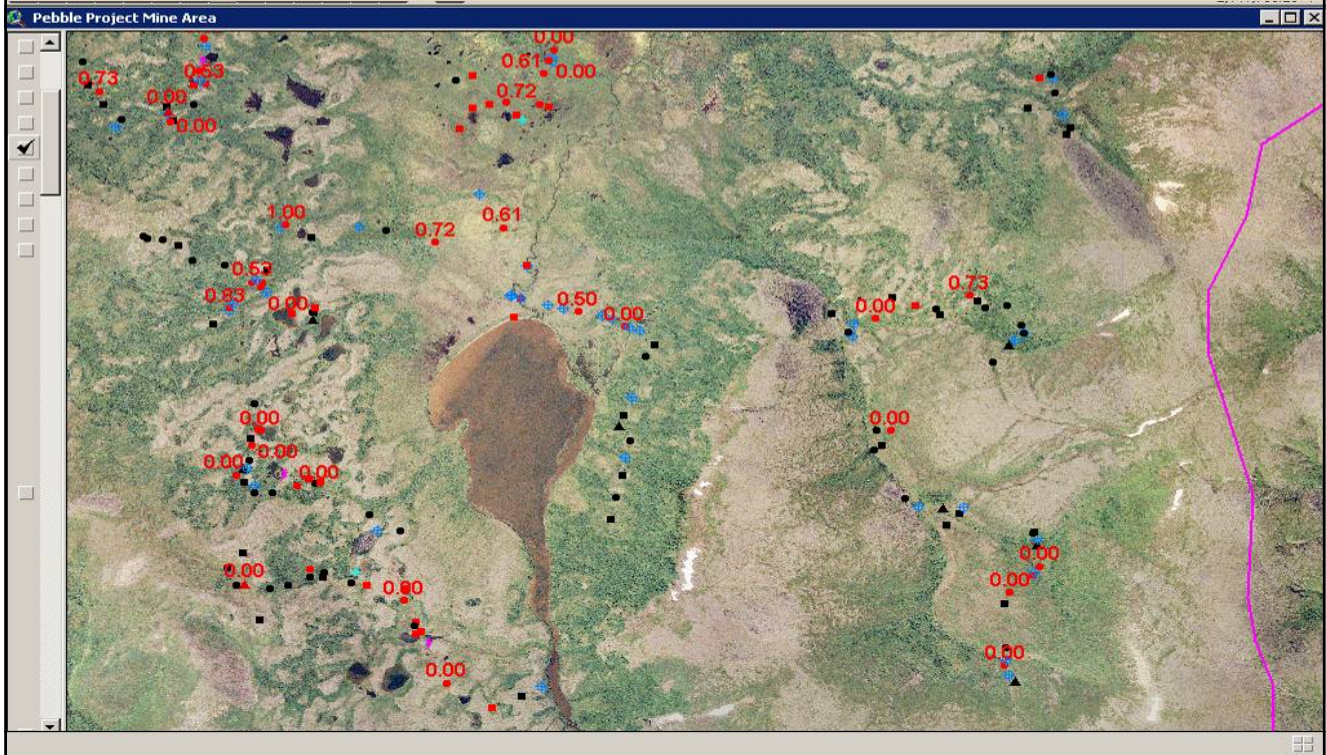
A Preliminary Sampling of Model 6 Results

Export of Detritus
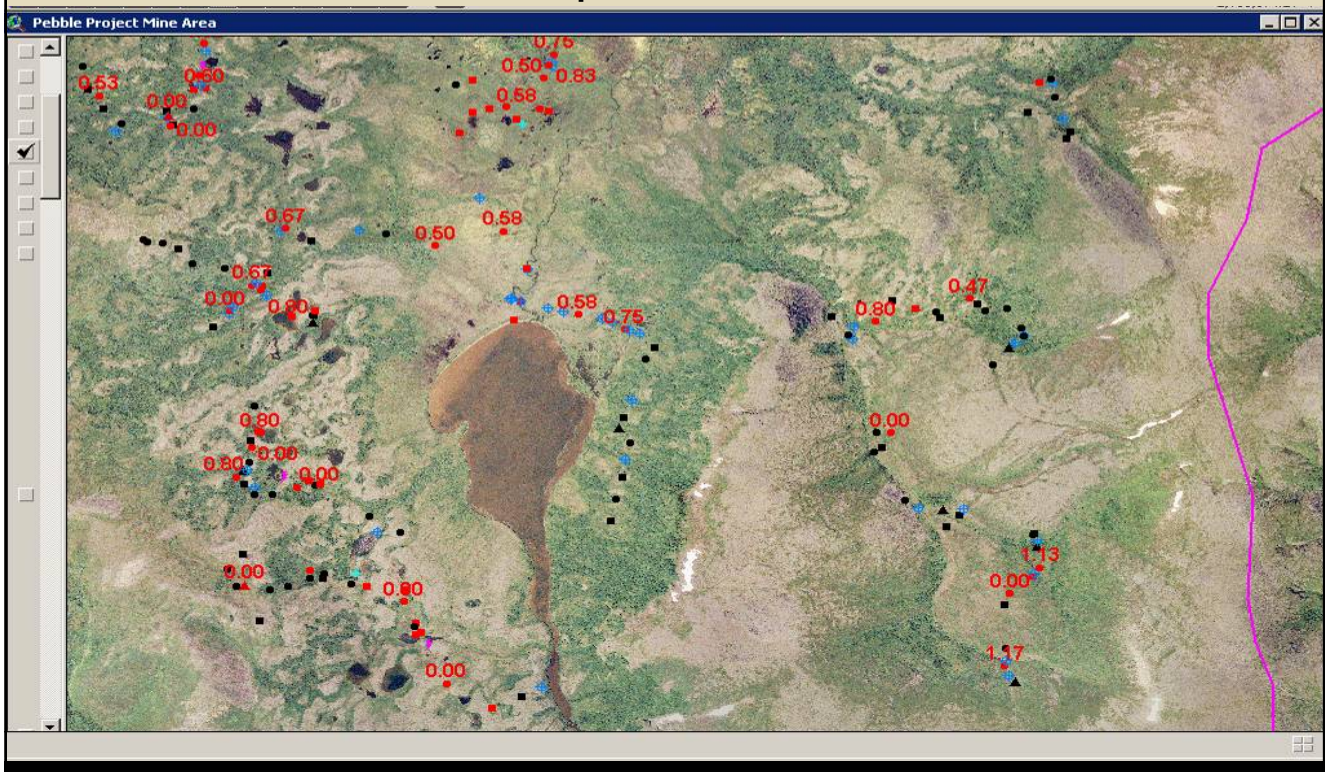
A Preliminary Sampling of Model 7 Results

Abundance & Diversity of Wetland Vegetation

Three Parameters +

Natural Resource Consulting
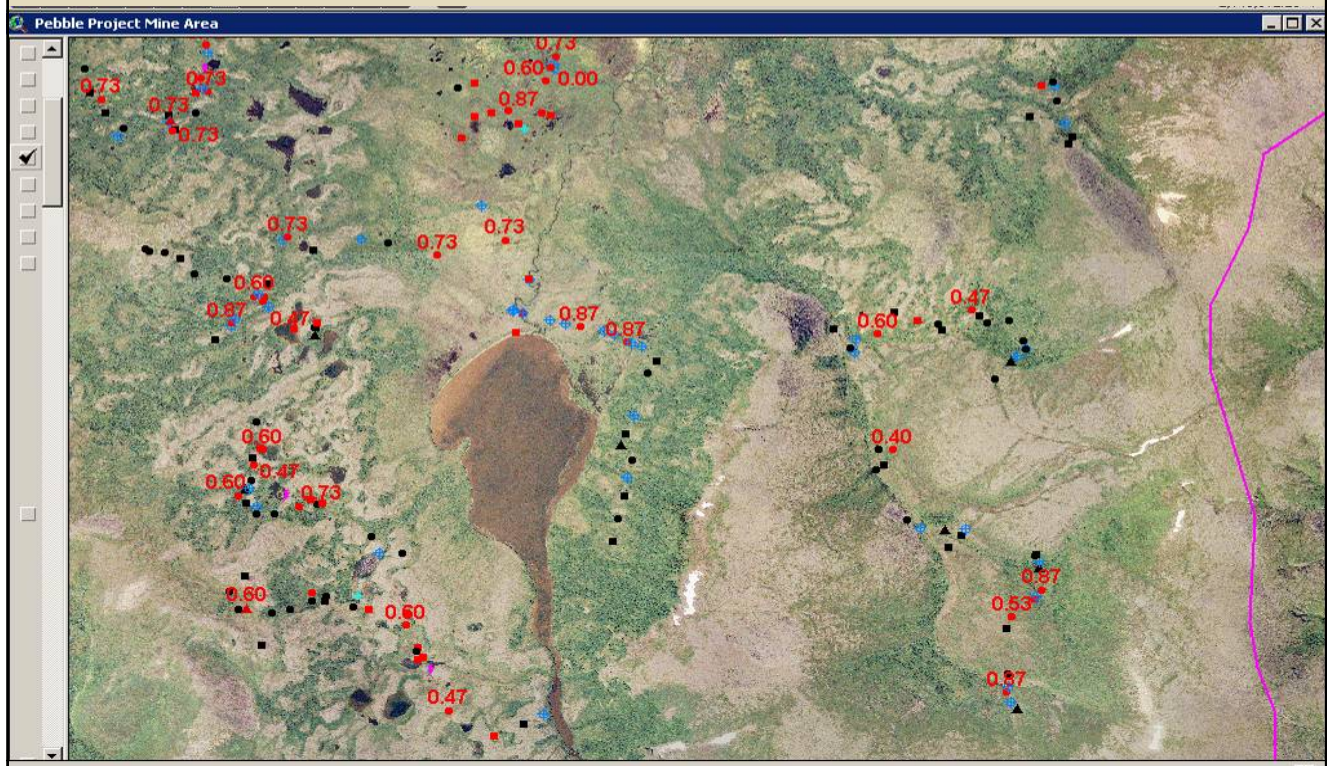
A Preliminary Sampling of Model 8 Results
Contribution to Abundance and Diversity of Wetland Fauna
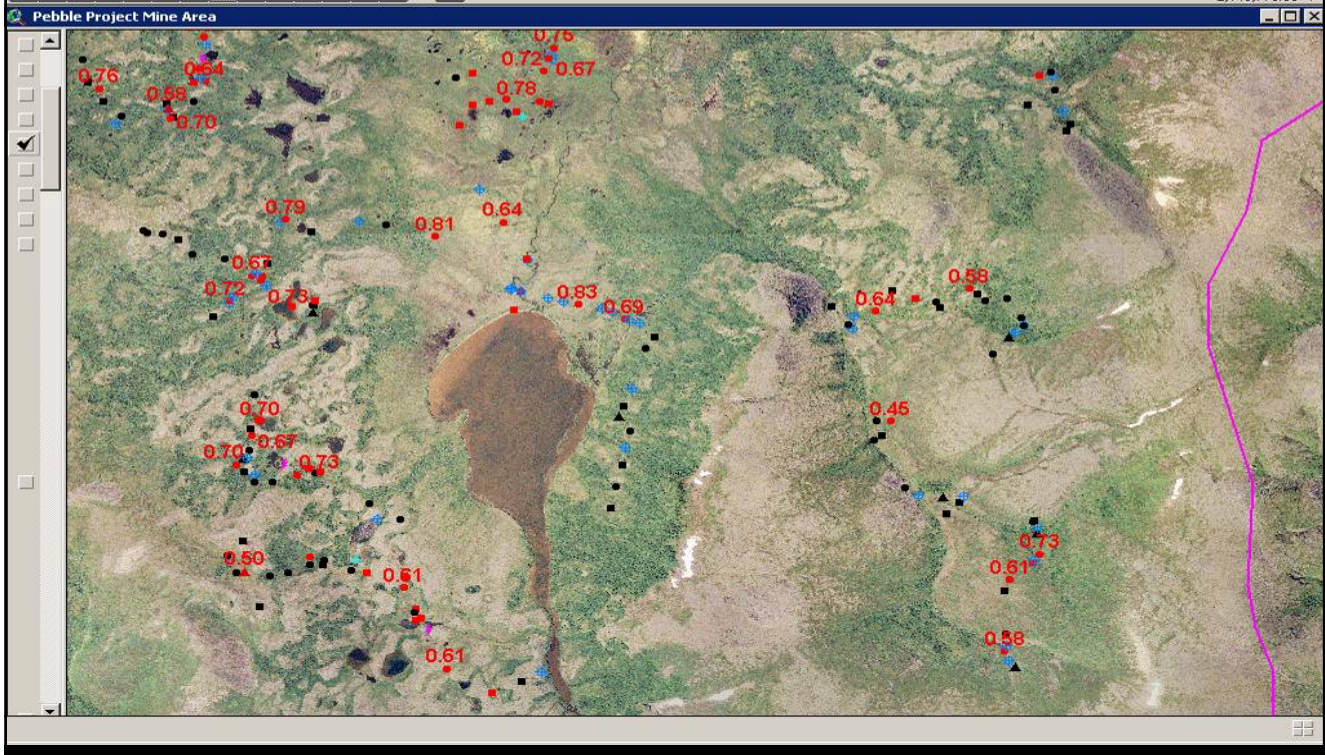
Major Study Components

✓ **Delineation**

✓ **Classify Wetlands & Assess Their Functions**

Consider Wetland Values

Incorporate Subsistence, Recreation, Cultural Resource, and Other "Values" into the Functional Assessment Evaluation

Identify & Evaluate Potential Compensatory Mitigation Projects

Prepare Compensatory Mitigation Plan

Per June 10, 2004 Final Alaska District Compensatory Mitigation Guidelines

THREE PARAMETERS+
Natural Resource Consulting

Three Parameters +

Natural Resource Consulting

Working Group Volunteers?

Consider Wetland Values

Incorporate Subsistence Use, Recreational Use, Cultural Resources, and Other "Values" into the Functional Assessment Process

THREE
PARAMETERS+
Natural Resource Consulting

Three Parameters +   Natural Resource Consulting

Mitigate =

Avoid

Minimize

Compensate ←

Identify Potential Compensatory Mitigation Opportunities

THREE PARAMETERS+
Natural Resource Consulting

Wetland Protection Concepts

• Advanced Identification Projects for Regional Wetlands at Risk from ATV Abuse, Stream Bank Erosion, etc.

• Fund Local Training Programs to Teach Installation of Trail Hardening & Stream Bank Restoration Techniques

• Fund ATV Trail Hardening & Stream Bank Protection Projects Using Locally Trained Workforce

• Fund Wetland/Riparian Educational Programs in Local Schools

THREE PARAMETERS+
Natural Resource Consulting

Wetland Restoration and Creation Concepts

– Develop Local Workforce & Expertise

– Develop Native Plant Nursery/Seed Bank

– Fund Graduate Student Projects to Expand Knowledge Base and Monitor All Reclamation/Restoration/Creation Projects

– Fund Scholarships for Local Youth to Pursue Careers in Wetland Restoration/Science

– Wetland Creation Projects for Sewage Treatment in Villages and Other Village Sanitation Projects

THREE PARAMETERS+
Natural Resource Consulting

2006 CMP Focus

Identify abandoned mines with potential wetland or stream restoration projects or other water quality issues:

- Bristol Bay Region

- Lower Kenai

- Fairbanks Area

Picture Courtesy of Aero-metric Inc.

Abandoned Mines Review & Selection Process

Presented by Cal Kerr

November 28, 2006

northerneconomics

Objective

northern economics

- **Locate abandoned Alaska mines for potential mitigation**

- **Develop a process for further site analysis and potential treatment**

Mine Selection Process

northern economics

- Locate mine data >
- Analyze data >
- Organize database >
- Organize spatial data (GIS) >
- Use Mine Site Criteria >
- Select mine site(s) >

- State, federal
- MS Access, ArcMap
- RDI
- RDI
- Three areas (SW, Kenai, Fairbanks)

Step 1. Locate Mine Data

northern economics

- **State, Industry**
- **http://ardf.wr.usgs. gov/**
- **State DNR – Joe Wehrman**
- **State DNR – Tom Crafford**

- **Federal:**
  - BLM
  - USGS
  - US Bureau of Mines
  - Coal Mines Data – held by DNR, Joe Wehrman

Step 2. Analyze mine data

northern economics

- **Raw ARDF data: 7,183 sites with 1,425 mines, potentially abandoned**
- **32 attributes noted for each mine (location, history, mining district, etc.)**
- **Data sent to RDI, database and spatial data "cleaning"**

Step 2. View Candidate Mines, Southwest Alaska, Raw ARDF Data
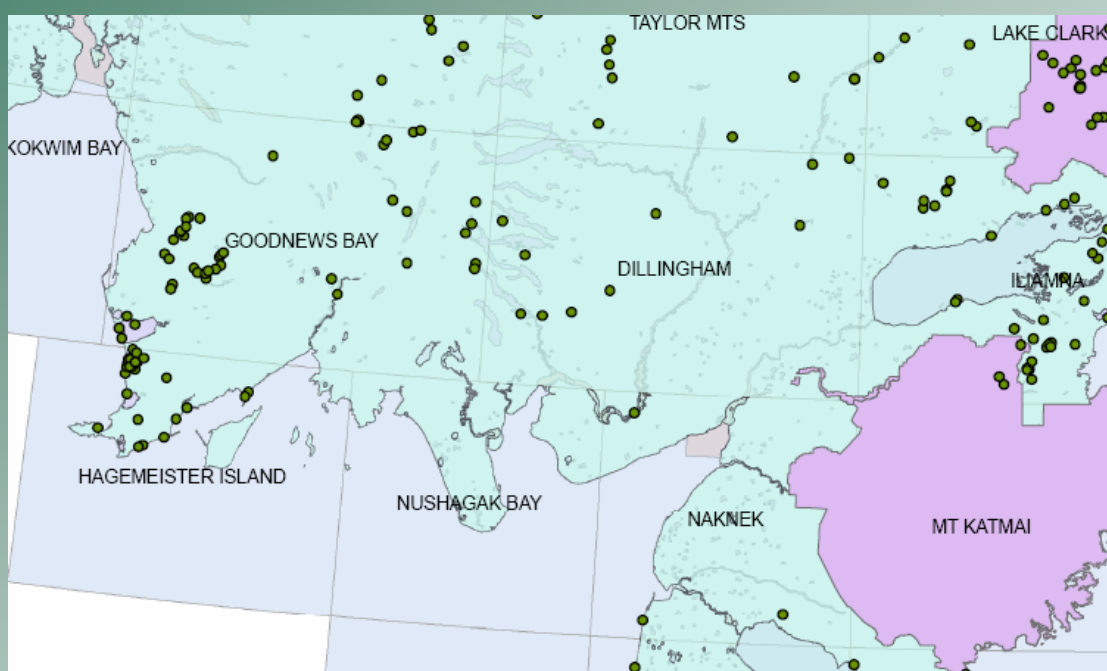
Step 3. Organize Database

northern economics

- **Database linked to PDFs**
- **Some text data condensed (less than 10 mines)**
- **Mining Districts added spatially on map and by attribute in database:**

	A	B	C	D	E	F	G	H	
1	ARDF_NUM	SITE	DISTRICT	COMM_M	QUAD_250	QUAD_63360	LATITUDE	LONGITUDE	LOCATION
2	AF003	Raspberry Beach	Kodiak	Au	AF	A-5	58.10000	-153.34000	This site is t
3	AK001	Unnamed (on Salt Island	Aleutian Islands	Cu	AK	C-2	52.17000	-174.64000	This mine is

Step 4. Organize GIS

northern economics

- **Test prints, settle on Mining Districts**
- **Add coal mining sites (n=402), exclude oil and gas sites**
- **Re-run maps and data with 1,827 total mines**
- **Add numbering for coal mines**

Step 5. Test Mine Site Criteria

northern economics

- **Select candidates for three areas: Southwest Alaska, Kenai Peninsula (West and East), Fairbanks**
- **Print working maps for initial review**
- **Refine selection process on SW Alaska**

Step 6. Select Mine Site

northern economics

- **Aerial photos ordered, AeroMetrics**
- **Two flights available**
- **RDI prepared three maps**
- **Two types selected**
- **Status plats researched, ownership determined**

Summary

northern economics

- **A total of 1,827 potential abandoned Alaska mines were identified from federal, state, and industry sources**

- **Both map and site data contributed to mine identification**

- **Candidate mine sites will be visited by interdisciplinary teams**

Three Parameters +   Natural Resource Consulting

Major Study Components

✓ **Delineation**

✓ **Classify Wetlands & Assess Their Functions**

✓ **Consider Wetland Values**

✓ **Identify & Evaluate Potential Compensatory Mitigation Projects**

Prepare Compensatory Mitigation Plan

THREE PARAMETERS+
Natural Resource Consulting

Three Parameters +   **Natural Resource Consulting**

Mitigate =

Avoid

Minimize

Compensate ←

Prepare Compensatory Mitigation Plan

Per June 10, 2004 Final Alaska District Compensatory Mitigation Guidelines & Pending Rule Changes Published in the Federal Register this Summer

THREE PARAMETERS+
Natural Resource Consulting

Three Parameters +   Natural Resource Consulting

Final Alaska District Compensatory Mitigation Guidelines

Emphasize:

     In-Kind-on-Site before In-Kind-Off-Site

     Out-of Kind-On-Site before Out-of Kind-Off-Site

     Wetland Restoration Over Creation

     Avoid Over-Engineered Structures in the Design

     Restore or Develop Naturally Variable Hydrological Conditions

     Consider Complications in Seriously Degraded or Disturbed Sites

     Conduct Early Monitoring

     Consider the Hydrogeomorphic and Ecological Landscape and Climate

     Adopt a Dynamic Landscape Perspective

     Pay Attention to Subsurface Conditions…

     Appropriate Planting Elevations, Depths, Soil Types, and Seasons

     Provide Appropriately Heterogeneous Topography

THREE PARAMETERS+
Natural Resource Consulting

Three Parameters +   Natural Resource Consulting

Major Study Components

✓ **Delineation**

✓ **Classify Wetlands & Assess Their Functions**

✓ **Consider Wetland Values**

✓ **Identify & Evaluate Potential Compensatory Mitigation Projects**

✓ **Prepare Compensatory Mitigation Plan**

THREE PARAMETERS+
Natural Resource Consulting

Three Parameters + — Natural Resource Consulting

Mapping & More Mapping

Draft Vegetation Sections of EBD

More Field Work

Expansion of the Small Pools Study to UT & NFK

Recon Visits to Potential Abandoned Mines

Continue Review of Abandoned Mines Statewide

2007 Work Plan

My Hardworking…Nearly Always Smiling… 2006 Field Crew

Subcontractor-Dr. Mark Rains

Jon Hall

Steve Reidsma

Rebecca Wachter

Subcontractor's Bill Kleindl & Justin Miner

Chris Love

Scott McArt

Special Thanks to Bear Guards Tamara Hedlund and Lary Hill

Subcontractor Andrea Hunter

Denise Herzog

Dr. Kai Rains

Jessica Moody

Not Pictured: Dr. Tony Hartshorn